Formalized classification of the vegetation of alder carr and floodplain forests in the Czech Republic

Formalizovaná klasifikace vegetace mokřadních olšin a lužních lesů v České republice

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A formalized and supervised phytosociological classification of *Alnion glutinosae* and *Alnion incanae* in the Czech Republic is presented. Three associations of *Alnion glutinosae* (*Thelypterido palustris-Alnetum glutinosae*, *Carici elongatae-Alnetum glutinosae* and *Carici acutiformis-Alnetum glutinosae*) and seven of *Alnion incanae* (*Alnetum incanae*, *Stellario nemorum-Alnetum glutinosae*, *Pruno-Fraxinetum*, *Carici remotae-Fraxinetum*, *Piceo-Alnetum*, *Ficario-Ulmetum campestris* and *Fraxino pannonicae-Ulmetum*) were distinguished by the Cocktail method using sociological species groups. Information about their syntaxonomy, species composition, ecology and distribution is presented. Ellenberg's indicator values were used to show the main ecological gradients responsible for the variation in the vegetation of these communities. The most important factors affecting this variation were temperature (for *Alnion incanae*) and soil reaction, nutrient availability and moisture (for *Alnion glutinosae*).

K e y w o r d s: Cocktail method, ecological gradients, phytosociology, riparian forests, wetland forests

Introduction

The alliances of *Alnion glutinosae* (alder carr) and *Alnion incanae* (floodplain forests) comprise azonal communities growing in places with a high groundwater table. The communities of both these alliances are widely distributed in Europe (Bodeux 1955, Oberdorfer 1953, Mucina et al. 1993, Dierßen 1996, Neuhäuslová 2000, 2003).

Alder carr forests of *Alnion glutinosae* occur in localities with a high stagnant groundwater table: in most cases around fishponds, oxbows and large spring fed areas. *Alnus glutinosa* most frequently dominates the tree layer (Bodeux 1955). The only large phytosociological synthesis of *Alnion glutinosae*, based on relevés from a great part of Europe, is published by Bodeux (1955). He distinguished four associations of alder carr on the basis of phytogeography. Since 1955 other studies on the classification of *Alnion glutinosae*, but for smaller geographical areas, have been published. Most of these take into account site condition rather than phytogeography (e.g., Passarge & Hofmann 1968, Döring-Mederake 1990, Mucina et al. 1993, Prieditis 1997, Matuszkiewicz 2002, Neuhäuslová 2003, Dengler et al. 2004, Willner & Grabherr 2007).

In the Czech Republic the first synthesis was published by Klika (1940). Other studies on alder carr are for different parts of the Czech Republic (e.g., Mikyška 1956, 1964, 1968, Jílek 1958, Neuhäusl & Neuhäuslová 1965, Turoňová 1985, 1987, Chytrý & Vicherek 1995, Kolbek et al. 2003, Douda 2004). Recently Moravec et al. (1995) and

Neuhäuslová (2003) proposed a classification reflecting gradients in nutrient availability and soil reaction. They distinguish three associations (*Carici acutiformis-Alnetum glutinosae*, *Carici elongatae-Alnetum glutinosae* and *Calamagrostio canescentis-Alnetum glutinosae*). This approach is based on the studies of Mikyška (1956, 1968).

Floodplain forests of *Alnion incanae* occur on fluvial sediments along rivers, streams and spring fed areas. This vegetation is influenced by floods and fluctuating groundwater table. The majority of the recent studies on the classification of floodplain forests in central Europe use the approach of Oberdorfer (1953). For the Czech Republic there are many studies on floodplain forests (Mezera & Samek 1954, Mezera 1956, Horák 1960, Dovolilová-Novotná 1961, Bednář 1964, Neuhäuslová-Novotná 1965, 1972, 1974, 1975, 1977, 1979, Moravec et al. 1982, Sedláčková 1987, Moravec et al. 1995, Neuhäuslová & Kučera 2004, Douda 2004). In the "Vegetation survey of the Czech Republic", Neuhäuslová (2000) distinguishes ten associations assigned to two suballiances (*Alnenion glutinoso-incanae* and *Ulmenion*). Four associations belong to streamside forests (*Pruno-Fraxinetum*, *Stellario-Alnetum glutinosae*, *Arunco sylvestris-Alnetum glutinosae* and *Alnetum incanae*), two to spring fed forests (*Carici remotae-Fraxinetum* and *Piceo-Alnetum*) and four to alluvial hardwood forests in large river valleys or basins (*Querco-Ulmetum*, *Querco-Populetum, Fraxino-Populetum* and *Fraxino pannonicae-Ulmetum*).

The above-mentioned Czech studies use a non-formalized approach to classification. The main problem with a non-formalized approach is the fact that the relevés are assigned to vegetation units subjectively rather than by using a precisely defined classification algorithm (Chytrý 2000). Despite these methodological reservations, it is important to appreciate the impressive number of phytosociological relevés collected: about 2,700 phytosociological relevés of the *Alnion glutinosae* and *Alnion incanae* alliances are currently available in the Czech National Phytosociological Database (Chytrý & Rafajová 2003). This data is suitable for carrying out a large phytosociological synthesis using a formalized classification approach. In this paper, the formalized Cocktail method used in the project "Vegetation of the Czech Republic" is applied. The main advantages of this method compared to numerical classifications are: stability of the classification results independent of the structure of the data set (Bruelheide & Chytrý 2000), the principles of data processing are similar to those used in traditional phytosociology (Bruelheide 2000, Chytrý 2000) and it is possible to reproduce the traditionally distinguished units (Kočí et al. 2003, Havlová 2006, Chytrý 2007, Boublík et al. 2007, Roleček 2007). The main disadvantage of this method is that it may not capture all variability of the vegetation (Bruelheide & Chytrý 2000).

The aims of this paper are to (i) propose a formalized phytosociological classification of alder carr and floodplain forests in the Czech Republic, which reproduces the traditionally distinguished associations, (ii) carry out a nomenclatural revision of the distinguished associations, and (iii) indicate the major environmental gradients responsible for the variation in the vegetation of these communities.

Material and methods

The data processing closely follows the approach used in the project "Vegetation of the Czech Republic" (Chytrý 2007). The classification is based on phytosociological relevés obtained from the Czech National Phytosociological Database (Chytrý & Rafajová 2003). This database contains relevés from all the vegetation types reported from the Czech Republic. A geographical and ecological stratification of relevés was performed because of uneven geographical distribution of relevés and vegetation types (Knollová et al. 2005). The stratification was carried out in such a way that only one relevé of each association or alliance was selected for each unit of the geographical grid dividing the Czech Republic into quadrangles of 1.25 longitudinal × 0.75 latitudinal minutes (ca 1.5 × 1.4 km). Preference was given to the most recent relevés and those including moss records. The resulting stratified database contained 43,814 relevés. Then, the same species from different layers were merged and only the exceptionally recorded juvenile trees and shrubs were excluded from further analysis (Chytrý 2007).

In order to reproduce the traditional associations, the Cocktail method was used for classification (Bruelheide 2000, Kočí et al. 2003, Havlová 2006, Chytrý 2007, Roleček 2007). Only associations containing unique diagnostic species were distinguished. The associations were defined by sociological species groups, which include co-occurring species, i.e., species with similar ecology and distribution. Co-occurrence of species was quantified using the phi coefficient of association, which ranges from –1 to +1. Positive values of this coefficient indicate a positive association between the species, i.e., the species occur frequently together and only rarely separately. On the other hand, negative values indicate a negative association between the species, i.e., the species occur mostly frequently separately and only rarely together (Chytrý et al. 2002).

Sociological species groups were defined subjectively based on expert knowledge. The basis for the constitution of sociological species groups was the whole stratified database (43,814 relevés). First, one species characteristic of the target vegetation unit was chosen and then the Juice program (Tichý 2002) was used to determine which of the other species occur most frequently with the chosen species, using the phi coefficient of association (Chytrý et al. 2002). Subsequently, these two species were grouped, and the phi value was calculated between the occurrence of the two-species group and another species. The same procedure was repeated with a three-species group and so on. In this way sociological groups of species, which have a statistical tendency to co-occur in the whole stratified database of relevés, were created (Havlová 2006). It is important to note that a species can be included only in one species group. The minimum number of species per group was fixed at three. A sociological species group was recorded in a relevé, if that relevé contained at least half the number of species defining the sociological species group (Chytrý 2007).

The definitions of associations were created by combinations of sociological species groups using logical operators such as AND, OR and NOT (see the definitions in Results and discussion and the composition of sociological species groups in Table 1). Dominance of single species was also used for the delimitation of associations. A threshold cover value of 5% was used as a dominance criterion. The only exception was the geographically defined association *Ficario-Ulmetum campestris*. In this case, the definition was based on the absence of *Fraxinus angustifolia*. Phytosocological units commonly reported in the Czech Republic (e.g., Neuhäuslová 2000, 2003) were distinguished because they encompass reasonably well the variability of alder carr and floodplain forests, but other units not distinguished in the above papers were also considered.

Table 1. – List of sociological species groups used for defining the associations.

Species group	Species
Group Asarum europaeum	*Asarum europaeum*, *Campanula trachelium*, *Polygonatum multiflorum*, *Pulmonaria officinalis* s.l.
Group Caltha palustris	*Angelica sylvestris*, *Caltha palustris*, *Galium uliginosum*, *Myosotis palustris* agg., *Scirpus sylvaticus*
Group Cardamine amara	*Cardamine amara*, *Chaerophyllum hirsutum*, *Chrysosplenium alternifolium*, *Crepis paludosa*
Group Carex acuta	*Carex acuta*, *Carex vesicaria*, *Lythrum salicaria*
Group Carex elongata	*Calamagrostis canescens*, *Carex elongata*, *Lysimachia thyrsiflora*, *Peucedanum palustre*
Group Carex panicea	*Cirsium palustre*, *Carex nigra*, *Carex panicea*, *Valeriana dioica*
Group Carex remota	*Carex remota*, *Carex sylvatica*, *Festuca gigantea*, *Stachys sylvatica*
Group Carex rostrata	*Carex rostrata*, *Equisetum fluviatile*, *Menyanthes trifoliata*, *Potentilla palustris*
Group Cirsium oleraceum	*Cirsium oleraceum*, *Geranium palustre*, *Filipendula ulmaria*
Group Corydalis cava	*Adoxa moschatellina*, *Anemone ranunculoides*, *Corydalis cava*, *Gagea lutea*
Group Galium odoratum	*Dentaria bulbifera*, *Galium odoratum*, *Mycerlis muralis*, *Viola reichenbachiana*
Group Geranium sylvaticum	*Cardaminopsis halleri*, *Cirsium heterophyllum*, *Crepis mollis*, *Geranium sylvaticum*, *Phyteuma spicatum*, *Silene dioica*
Group Iris pseudacorus	*Glyceria maxima*, *Iris pseudacorus*, *Sium latifolium*
Group Lathyrus vernus	*Galium sylvaticum*, *Hepatica nobilis*, *Lathyrus vernus*, *Melica nutans*
Group Lysimachia vulgaris	*Galium palustre* agg., *Lycopus europaeus*, *Lysimachia vulgaris*, *Scutellaria galericulata*
Group Mercurialis perennis	*Geranium robertianum, Galeobdolon luteum* s.l., *Mercurialis perennis, Actaea spicata*
Group Petasites albus	*Cicerbita alpina*, *Petasites albus*, *Stellaria nemorum*, *Thalictrum aquilegiifolium*
Group Prunus padus	*Euonymus europaeus*, *Prunus padus* subsp. *padus*, *Ribes rubrum*
Group Symphytum officinale	*Glechoma hederacea* s.l., *Lysimachia nummularia*, *Poa trivialis*, *Ranunculus repens*, *Symphytum officinale*
Group Urtica dioica	*Aegopodium podagraria*, *Anthriscus sylvestris*, *Lamium maculatum*, *Urtica dioica*
Group Vaccinium myrtillus	*Avenella flexuosa*, *Dicranum scoparium*, *Polytrichum formosum*, *Vaccinium myrtillus*
Group Viola palustris	*Agrostis canina*, *Aulacomnium palustre*, *Carex echinata*, *Viola palustris*

All relevés from the stratified database were classified on the basis of association definitions. Subsequently the frequency-positive fidelity index (FPFI) was calculated for the relevés that were assigned to more than one association. This index, based on species composition and the presence of diagnostic species, measures the similarity of a relevé to those of particular associations (Tichý 2005). Relevés were assigned to these candidate associations with which they had the highest FPFI value.

The diagnostic species of particular units were determined in the following way. Firstly, the numbers of relevés per unit were equalized to 1% of the total data set with the help of the Juice program (Tichý 2002, Tichý & Chytrý 2006). Secondly, the phi coefficient was used to examine of species concentration in relevés of particular associations within the whole data set (Chytrý et al. 2002). Only species with a high value for this index (i.e. ≥ 0.25) were considered as diagnostic species. The moss layer was included in the analysis, although it was not recorded in all relevés included in the database. However, the fidelity and frequency values for mosses were based only on the relevés with mosses recorded. Finally, Fisher's exact test ($p < 0.001$) was used for eliminating the fidelity value of species with a non-significant pattern of occurrence (Chytrý et al. 2002, Chytrý 2007). A synoptic table with calculated frequency and fidelity for particular species was created in order to determine differences in species composition among particular associations.

The total unstratified data set of *Alnion glutinosae* and *Alnion incanae* (where relevés were assigned to alliances by their authors) was classified using Cocktail definitions in order to create maps of associations.

Relationships among associations were determined using detrended correspondence analysis (DCA) in the CANOCO 4.5 package (ter Braak & Šmilauer 2002). The strong influence of dominant species was eliminated using the square-root transformation of species cover data. Major environmental gradients were described using Ellenberg indicator values (Ellenberg et al. 1992). A simple average for soil reaction, nutrient, moisture, light, temperature and continentality was calculated for each relevé. Only factors correlated with the scores of relevés on the 1st or the 2nd ordination axis ($p < 0.001$) were plotted onto a DCA ordination diagram as supplementary environmental variables. Spearman correlation coefficients were calculated using Statistica program (StatSoft Inc. 2006). Mosses were excluded from the analysis because they were not recorded in all relevés.

The nomenclature of taxa follows Kubát et al. (2002) for vascular plants and Frey et al. (2006) for bryophytes. The delimitation of other species aggregates, denoted with the abbreviation "s.l.", follows Chytrý (2007).

Results and discussion

Out of the whole stratified data set, 101 and 415 relevés were assigned by Cocktail definitions and application of the FPFI to the *Alnion glutinosae* and *Alnion incanae* alliances, respectively. Only 33% of relevés of both *Alnion glutinosae* and *Alnion incanae* alliances, assigned originally by their authors to these alliances in the stratified database, were classified in the same way by the above-mentioned method. This seemingly poor result corresponds to field reality where many stands have transitional species compositions or lack diagnostic species. Roleček (2007), for instance, reaches similar conclusions for thermophilous oak forests in the Czech Republic. In the case of alder carr and floodplain forests there are strong competitors with clonal growth, such as *Urtica dioica* and *Carex brizoides*, which dominate in stands lacking diagnostic species. *Urtica dioica* frequently occurs on eutrophic and dry sites in *Alnion incanae*, whereas *Carex brizoides* is dominant on more oligotrophic and drier sites in communities of both alliances.

Three associations of *Alnion glutinosae* and seven of *Alnion incanae* were distinguished on the basis of the above-described method (see Table 1 for the composition of sociological species groups). Below are species composition, ecology, internal variability and distribution of distinguished associations (for more detailed information see Figs 1–3 and Table 2).

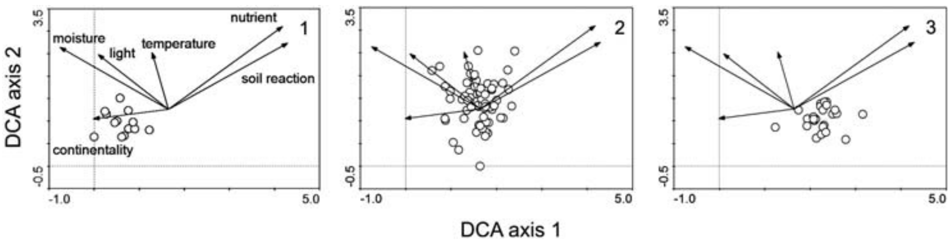

Fig. 1. – DCA ordination diagram of alder carr forests with Ellenberg indicator values as supplementary environmental variables. Only variables correlated with the scores of relevés on the 1st and/or the 2nd ordination axis ($p < 0.001$) are plotted. Units are separated in ordination space. The 1st and the 2nd ordination axes explain 4.3% and 3.1% ($n = 101$) of the total species variability, respectively. 1 – *Thelypterido palustris-Alnetum glutinosae*, 2 – *Carici elongatae-Alnetum glutinosae*, 3 – *Carici acutiformis-Alnetum glutinosae*.

Alnion glutinosae Malcuit 1929 (Alder carr)

1. *Thelypterido palustris-Alnetum glutinosae* Klika 1940 nom. invers. et mut. propos. (Oligotrophic *Sphagnum*-rich alder carr)

Original name: Klika (1940): *Alnus glutinosa-Dryopteris thelypteris*-Assoziation
Nomenclatural type: Klika (1940): 100, rel. 3 – lectotypus (Dengler et al. 2004)
Definition: *Alnus glutinosa* cover > 25% AND (*Betula pendula* cover > 5% OR *Betula pubescens* cover > 5% OR *Frangula alnus* cover > 5% OR *Pinus sylvestris* cover > 5%) AND (Group Carex rostrata OR Group Carex panicea OR Group Viola palustris) NOT (Group Caltha palustris OR Group Carex remota)

Sphagnum-rich alder community growing on peaty, waterlogged, nutrient-poor and acidic substrates. *Alnus glutinosa* and *Betula pubescens* dominate the tree layer together with an admixture of light demanding trees (*Pinus sylvestris* and *Betula pendula*). Due to the extreme soils, open stands with a stratified tree layer, dwarf trees and good light conditions develop. *Frangula alnus* commonly occurs in the shrub layer. Acidophilous and oligotrophic species such as *Carex canescens*, *C. nigra*, *Trientalis europaea*, *Vaccinium myrtillus* and *Viola palustris* are typical components of the herb layer. As for hydrophilous species, only those tolerant of nutrient-poor substrates are commonly present (e.g., *Equisetum fluviatile*, *C. rostrata* and *Phragmites australis*). The moss layer is usually well developed; a carpet of *Sphagnum* (e.g., *Sphagnum fimbriatum*, *S. palustre* and *S. recurvum* agg.) is characteristic.

Thelypterido palustris-Alnetum glutinosae occurs at low and middle altitudes (270–540 m), often on areas surrounding peat bogs and fishponds. It is widespread in the Ralská pahorkatina upland in N Bohemia (Břehyně, Hamerský and Hradčanský fishponds). However, it occurs less frequently in other regions of Bohemia (Plzeňská pahorkatina upland, Třeboňská pánev basin, Českomoravská vrchovina highland, Východolabská tabule lowland). In Europe, this association is recorded under different names in the Netherlands (Stortelder et al. 1999), Germany (Passarge & Hoffman 1968, Döring-Mederake 1990), Poland, E Baltic area (Solinska-Górnicka 1987, Prieditis 1997, Matuszkiewicz 2002), Slovakia (Šomšák 2000) and Austria (Willner & Grabherr 2007). From the phytogeographical point of view, the rare and scattered occurrence of oligotrophic *Sphagnum*-rich alder carr in the Czech Republic is related to the frequent occurrence of this boreal vegetation type in NE Poland and E Baltic area (Solinska-Górnicka 1987, Prieditis 1997).

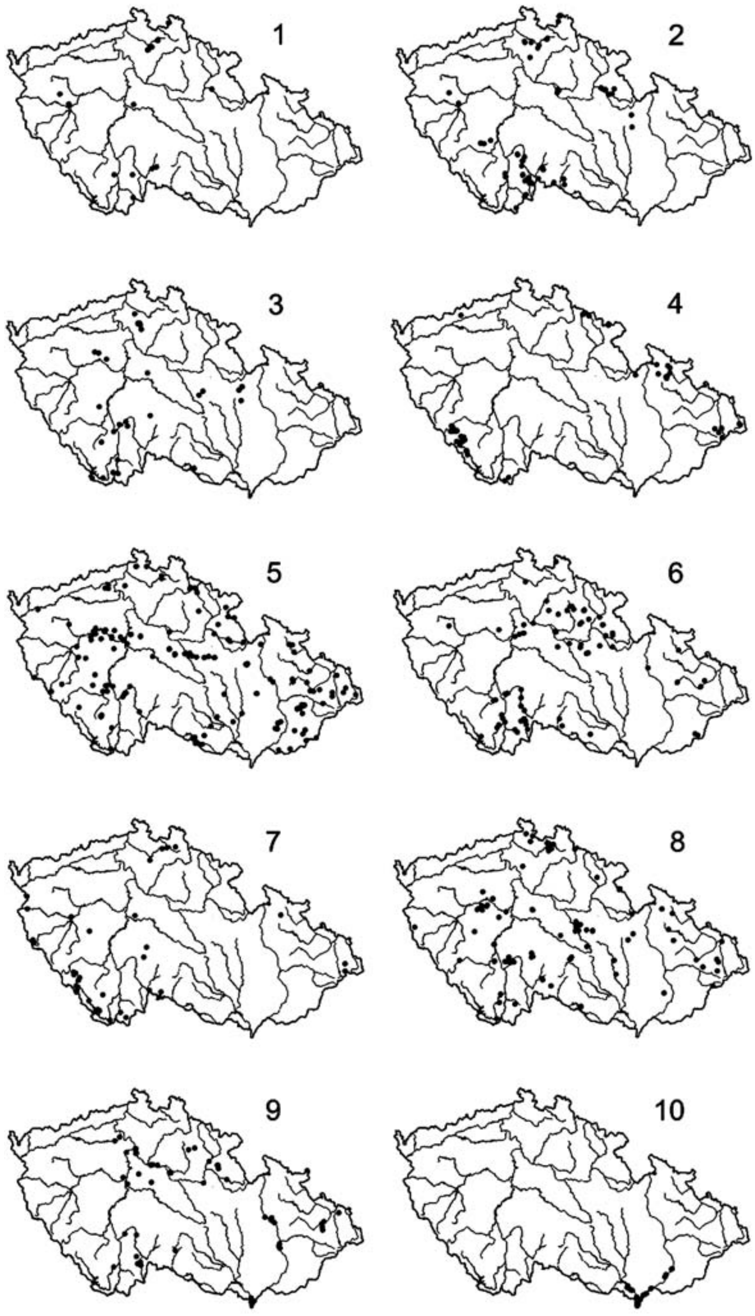

Fig. 2. – Distribution of alder carr and floodplain forest associations in the Czech Republic. 1 – *Thelypterido palustris-Alnetum glutinosae*, 2 – *Carici elongatae-Alnetum glutinosae*, 3 – *Carici acutiformis-Alnetum glutinosae*, 4 – *Alnetum incanae*, 5 – *Stellario nemorum-Alnetum glutinosae*, 6 – *Pruno-Fraxinetum*, 7 – *Piceo-Alnetum*, 8 – *Carici remotae-Fraxinetum*, 9 – *Ficario-Ulmetum campestris*, 10 – *Fraxino pannonicae-Ulmetum.*

Table 2. – Combined synoptic table of frequency and fidelity (phi coefficient × 100, upper indices) for the associations of alder carr and floodplain forests. Only species with phi coefficient ≥ 0.25 (frequency and fidelity in grey) are considered as diagnostic species (D.S.). Species with a frequency > 20% in some units or > 10% in the whole alliance are considered as other species. 1 (TA) – *Thelypterido palustris-Alnetum glutinosae*, 2 (CeA) – *Carici elongatae-Alnetum glutinosae*, 3 (CaA) – *Carici acutiformis-Alnetum glutinosae*, 4 (Ai) – *Alnetum incanae*, 5 (SA) – *Stellario nemorum-Alnetum glutinosae*, 6 (PF) – *Pruno-Fraxinetum*, 7 (PA) – *Piceo-Alnetum*, 8 (CrF) – *Carici remotae-Fraxinetum*, 9 (FU) – *Ficario-Ulmetum campestris*, 10 (FpU) – *Fraxino pannonicae-Ulmetum.*

Group no.	1	2	3	4	5	6	7	8	9	10
Association	TA	CeA	CaA	Ai	SA	PF	PA	CrF	FU	FpU
No. of relevés	13	64	24	52	126	67	23	59	41	47
D.S. *Thelypterido palustris-Alnetum glutinosae*										
Carex canescens	77^{43}	14^{8}	4	.	.	.	17	2	.	.
Betula pubescens	46^{43}	20^{21}	4	8^{8}	1	.	4	.	.	.
Sphagnum fimbriatum	30^{37}	.	.	.	.	.	.	.	.	.
Plagiothecium denticulatum	50^{36}	17^{12}	.	9	8^{6}	.	.	9	.	.
Phragmites australis	62^{31}	22^{11}	12	.	.	9	.	.	.	2
Equisetum fluviatile	62^{30}	22^{10}	38^{18}	.	.	1	.	3	.	.
Carex nigra	85^{28}	3	4	.	.	.	9	2	.	.
Trientalis europaea	38^{26}	.	.	.	.	.	.	.	.	.
Marchantia polymorpha	20^{26}	.	.	.	1	.	.	3	.	.
Carex rostrata	54^{25}	3	8	.	.	1	4	.	.	.
Potentilla palustris	38^{25}	.	.	.	.	.	.	.	.	.
D.S. *Carici elongatae-Alnetum glutinosae*										
Calamagrostis canescens	23^{20}	52^{42}	.	.	.	7^{6}	.	.	.	.
Iris pseudacorus	8	47^{34}	8	.	.	13^{10}	.	.	5	21^{16}
D.S. *Carici acutiformis-Alnetum glutinosae*										
Scirpus sylvaticus	31	42^{14}	96^{34}	8	4	9	17	17	.	.
Carex acutiformis	.	20^{17}	42^{33}	.	2	12^{10}	.	3	.	2
Caltha palustris	31	64^{21}	92^{31}	46^{14}	27^{7}	31^{9}	48^{15}	64^{21}	.	.
Filipendula ulmaria	8	42^{12}	92^{30}	56^{17}	30^{8}	46^{14}	30	51^{15}	20	2
Veronica beccabunga	8	5	33^{28}	4	5	1	13	19^{16}	.	.
D.S. *Alnetum incanae*										
Thalictrum aquilegiifolium	.	2	.	54^{57}	5^{5}	1	.	3	.	.
Silene dioica	.	.	.	71^{48}	10^{6}	6	13	.	12^{8}	.
Stellaria nemorum	.	5	12	87^{42}	49^{24}	31^{15}	22^{10}	44^{22}	10	4
Petasites albus	.	.	.	71^{42}	21^{12}	.	4	8	.	.
Doronicum austriacum	.	.	.	27^{40}	.	.	.	2	.	.
Valeriana excelsa	.	6^{7}	8	38^{40}	6^{6}	4	9	5	7	.
Cardaminopsis halleri	.	.	.	44^{37}	2	3	9	2	10^{9}	.
Aconitum plicatum	.	.	.	27^{34}	.	.	9	.	.	.
Salix caprea	.	.	.	25^{31}	2	3	.	.	.	.
Geum rivale	.	2	12	42^{30}	8^{5}	6	17^{12}	7	.	.
Phyteuma spicatum	.	.	.	40^{28}	7^{4}	3	.	2	.	.
Senecio nemorensis agg.	15	11	38^{10}	92^{28}	40^{10}	18	65^{19}	54^{15}	7	.
Cicerbita alpina	.	.	.	19^{25}	.	.	4	2	.	.
Ranunculus platanifolius	.	.	.	19^{25}	1	.	.	.	.	.

Group no.	1	2	3	4	5	6	7	8	9	10
Association	TA	CeA	CaA	Ai	SA	PF	PA	CrF	FU	FpU
No. of relevés	13	64	24	52	126	67	23	59	41	47
D.S. *Stellario nemorum-Alnetum glutinosae*										
Ranunculus lanuginosus	.	.	.	15^{13}	40^{34}	4	.	16^{13}	2	2
Galeobdolon luteum s.l.	.	.	8	33^{11}	83^{30}	30^{10}	9	49^{18}	39^{13}	.
Euphorbia dulcis	.	.	.	6	33^{26}	6	.	17^{14}	7	.
Aegopodium podagraria	.	8	12	58^{17}	85^{26}	72^{22}	.	42^{12}	71^{22}	11
Asarum europaeum	.	.	4	23^{11}	54^{26}	24^{11}	4	17^{7}	10	.
Pulmonaria officinalis s.l.	.	.	.	15	60^{26}	49^{21}	.	12	29^{12}	34^{14}
D.S. *Pruno-Fraxinetum*										
Ribes rubrum	.	3	4	.	.	49^{62}	.	.	12^{22}	.
Euonymus europaeus	.	3	.	.	10^{9}	73^{60}	.	3	24^{23}	15^{14}
Humulus lupulus	.	17^{17}	4	.	6^{5}	42^{38}	.	5	15^{14}	2
Ribes uva-crispa	.	2	.	4	11^{10}	28^{26}	.	3	10^{9}	.
D.S. *Piceo-Alnetum*										
Equisetum sylvaticum	15	17^{9}	21^{11}	31^{17}	15^{8}	4	78^{43}	44^{25}	2	.
Scapania undulata	.	.	.	.	1	.	30^{40}	.	.	.
Pellia neesiana	.	.	.	9^{16}	.	.	20^{30}	.	.	.
Dryopteris dilatata	23	31^{12}	42^{16}	25^{9}	13^{4}	13	65^{26}	24^{8}	5	.
Picea abies	54^{17}	22^{6}	.	52^{17}	12	6	78^{26}	32^{9}	5	.
Phegopteris connectilis	.	.	.	6	1	1	26^{26}	2	.	.
D.S. *Carici remotae-Fraxinetum*										
Crepis paludosa	15	20^{8}	33^{14}	50^{22}	25^{10}	22^{9}	43^{18}	71^{31}	5	.
Plagiomnium undulatum	.	17	.	48^{22}	51^{23}	39^{18}	10	80^{36}	7	.
Chrysosplenium oppositifolium	.	.	.	4	2	.	4	17^{28}	.	.
D.S. *Ficario-Ulmetum campestris*										
Gagea lutea	.	.	.	.	6^{10}	13^{20}	.	.	46^{54}	4
Corydalis cava	.	.	.	.	5^{7}	9^{13}	.	.	49^{54}	.
Anemone ranunculoides	.	.	.	.	2	4	.	.	39^{45}	6^{9}
Adoxa moschatellina	.	.	.	2	11^{12}	24^{24}	.	3	41^{39}	.
D.S. *Fraxino pannonicae-Ulmetum*										
Fraxinus angustifolia	.	.	.	.	.	.	.	.	.	100^{94}
Rumex sanguineus	.	5	.	2	8^{11}	4	.	12^{16}	7^{10}	66^{65}
Aster novi-belgii s.l.	.	.	.	.	.	.	.	.	.	45^{53}
Cardamine impatiens	.	.	.	4	6^{6}	1	.	.	5	60^{50}
Acer campestre	.	.	.	.	19^{13}	21^{14}	.	.	32^{21}	79^{50}
Circaea lutetiana	.	.	8	.	36^{24}	21^{14}	.	17^{11}	12^{8}	77^{49}
Carex strigosa	.	.	.	.	.	.	.	.	.	21^{45}
Aristolochia clematitis	.	.	.	.	.	.	.	.	.	28^{45}
Dactylis polygama	.	.	4	2	10^{6}	6	.	5	24^{16}	70^{44}
Crataegus laevigata	.	.	.	.	5	18^{16}	.	.	20^{17}	53^{43}
Senecio erraticus	.	.	.	.	.	.	.	.	.	23^{36}
Eurhynchium angustirete	.	.	.	.	3	.	.	.	.	40^{35}
Veronica montana	.	.	4	6	6^{5}	1	.	24^{21}	2	38^{33}

Group no.	1	2	3	4	5	6	7	8	9	10
Association	TA	CeA	CaA	Ai	SA	PF	PA	CrF	FU	FpU
No. of relevés	13	64	24	52	126	67	23	59	41	47
Viola reichenbachiana	.	2	.	15	32^{11}	27^{9}	.	27^{10}	27^{9}	81^{31}
Carex sylvatica	.	.	.	15^{7}	40^{21}	33^{17}	9	37^{20}	20^{10}	60^{31}
Lysimachia nummularia	8	28^{9}	25	.	27^{8}	54^{18}	4	25^{8}	17	83^{29}
Glechoma hederacea s.l.	.	11	4	12	36^{13}	49^{19}	.	12	51^{19}	74^{29}
Torilis japonica	.	.	.	.	.	1	.	.	2	34^{28}
Lamium maculatum	.	.	4	27^{15}	34^{19}	28^{16}	.	2	39^{22}	49^{27}
Oxalis dillenii	.	.	.	.	.	.	.	.	.	9^{27}
D.S. common for several vegetation types										
Lysimachia thyrsiflora	54^{46}	42^{37}	.	.	.	1	.	.	.	.
Peucedanum palustre	62^{44}	58^{41}	.	.	.	.	4	.	2	.
Thelypteris palustris	23^{41}	16^{32}	.	.	.	.	.	.	.	.
Carex paniculata	38^{42}	11^{14}	29^{33}	.	.	.	.	.	.	.
Viola palustris	85^{38}	36^{16}	21	23^{10}	2	.	61^{28}	3	.	.
Scutellaria galericulata	62^{38}	48^{30}	21^{13}	2	.	6	.	.	.	2
Carex elongata	31^{32}	78^{68}	21^{23}	.	1	6^{7}	9	7^{8}	.	.
Salix cinerea	15	33^{36}	25^{29}	.	.	4	.	.	.	.
Lycopus europaeus	46^{20}	75^{33}	58^{26}	2	10	18^{7}	.	3	.	6
Galium palustre agg.	69^{21}	83^{26}	83^{26}	19	2	7	48^{14}	20	.	43^{12}
Cardamine amara	23	33^{18}	50^{27}	33^{18}	21^{11}	4	30^{17}	83^{44}	.	.
Ficaria verna subsp. *bulbifera*	.	3	.	4	33^{21}	55^{34}	.	20^{13}	68^{42}	11
Stachys sylvatica	.	3	8	42^{22}	71^{36}	58^{29}	.	47^{24}	34^{17}	43^{22}
Rubus caesius	8	9	8	2	13^{7}	51^{28}	.	5	22^{12}	89^{48}
Brachypodium sylvaticum	.	.	.	4	37^{17}	57^{27}	.	20^{9}	39^{18}	70^{33}
Athyrium filix-femina	46^{16}	42^{14}	33^{11}	79^{28}	48^{16}	18	74^{26}	63^{22}	5	.
Carex remota	8	12^{8}	4	6	24^{17}	15^{10}	22^{15}	59^{40}	7	70^{46}
Chrysosplenium alternifolium	.	3	12	56^{38}	32^{22}	1	26^{18}	51^{35}	.	.
Chaerophyllum hirsutum	.	5	29^{12}	92^{40}	37^{16}	9	43^{19}	64^{28}	2	.
Impatiens noli-tangere	.	48^{18}	50^{19}	77^{30}	60^{23}	54^{21}	39^{14}	68^{26}	46^{17}	4
Ulmus minor	.	2	.	.	4^{6}	10^{15}	.	.	22^{28}	36^{43}
Quercus robur	8	8	.	.	7	42^{20}	.	2	100^{48}	83^{40}
Ulmus laevis	.	2	.	.	.	7^{16}	.	.	15^{28}	17^{31}
Frangula alnus	92^{54}	42^{26}	42^{26}	.	3	13^{8}	22^{13}	3	2	.
Lysimachia vulgaris	85^{27}	92^{30}	88^{28}	4	17^{3}	45^{13}	13	20	15	13
Solanum dulcamara	38^{27}	66^{44}	54^{37}	.	3	18^{12}	4	8	.	.
Dryopteris carthusiana	77^{37}	78^{38}	17	10	17^{7}	21^{9}	61^{30}	31^{14}	10	.
Mnium hornum	30^{25}	8	30^{25}	6	2	.	50^{40}	11^{10}	.	.
Fraxinus excelsior	.	12	25^{11}	29^{13}	67^{32}	73^{34}	.	44^{21}	56^{26}	.
Sambucus nigra	.	5	17	12	49^{28}	58^{33}	.	12^{6}	49^{28}	2
Festuca gigantea	.	14^{7}	4	10	44^{25}	57^{32}	4	47^{26}	32^{18}	66^{36}
Geum urbanum	.	11	21	21^{7}	70^{27}	75^{29}	4	22^{7}	59^{23}	91^{36}
Alnus incana	.	2	4	100^{78}	9^{9}	10^{11}	61^{53}	24^{24}	.	.
Prunus padus subsp. *padus*	8	31^{26}	4	33^{27}	21^{18}	94^{68}	9	15^{13}	78^{58}	2
Alnus glutinosa	100^{49}	100^{49}	100^{49}	6	97^{48}	81^{40}	57^{29}	93^{46}	17^{8}	2
Other species										
Urtica dioica	8	67^{13}	79^{17}	81^{17}	72^{15}	91^{20}	43^{7}	78^{16}	80^{17}	91^{20}
Deschampsia cespitosa	46^{10}	52^{11}	62^{14}	71^{17}	37^{7}	37^{7}	74^{17}	58^{13}	27	91^{22}

Group no.	1	2	3	4	5	6	7	8	9	10
Association	TA	CeA	CaA	Ai	SA	PF	PA	CrF	FU	FpU
No. of relevés	13	64	24	52	126	67	23	59	41	47
Oxalis acetosella	8	27^{6}	17	71^{20}	67^{19}	25^{5}	83^{24}	59^{17}	27	.
Ranunculus repens	8	42^{8}	46^{9}	62^{13}	23^{2}	34^{6}	65^{14}	63^{13}	10	45^{8}
Rubus idaeus	23	38^{11}	33^{9}	79^{25}	32^{9}	40^{12}	74^{23}	36^{10}	20	.
Myosotis palustris agg.	.	42^{11}	67^{19}	77^{22}	19^{3}	15	65^{18}	64^{18}	2	11
Galium aparine	8	9	38^{9}	17	39^{9}	70^{19}	9	22	68^{18}	21
Ajuga reptans	.	5	4	40^{14}	39^{13}	42^{14}	43^{15}	49^{17}	15	53^{18}
Anemone nemorosa	.	6	25	48^{19}	40^{16}	48^{19}	22	39^{15}	59^{23}	2
Poa trivialis	8	42^{9}	71^{18}	25	18	33^{6}	35	34^{7}	29	15
Geranium robertianum	.	3	4	21^{7}	49^{18}	30^{10}	4	31^{11}	27^{9}	34^{12}
Acer pseudoplatanus	.	2	4	48^{20}	51^{22}	27^{11}	9	20^{8}	34^{14}	.
Impatiens parviflora	8	17^{6}	33^{14}	.	37^{16}	36^{15}	.	10	44^{19}	51^{22}
Carex brizoides	8	42^{21}	33^{16}	42^{21}	25^{12}	18^{8}	26^{13}	34^{18}	22^{10}	.
Angelica sylvestris	8	33^{9}	62^{20}	37^{11}	12	39^{12}	30	19	10	15
Phalaris arundinacea	.	50^{18}	25	27^{9}	18^{5}	30^{10}	4	15	12	28^{9}
Moehringia trinervia	8	9	.	25^{11}	18^{7}	42^{19}	9	19^{7}	46^{21}	36^{16}
Cirsium oleraceum	.	11	46^{19}	19^{7}	36^{15}	37^{16}	13	25^{10}	7	.
Mercurialis perennis	.	.	.	13	57^{23}	16^{5}	.	14	20^{7}	.
Rubus fruticosus agg.	46^{16}	27^{8}	4	12	28^{9}	21^{6}	13	25^{8}	15	.
Plagiomnium affine	40	42^{10}	70^{18}	52^{13}	16	13	40	49^{12}	27	20
Poa nemoralis	.	3	4	23	24^{5}	34^{9}	.	14	51^{14}	6
Atrichum undulatum	20	8	.	55^{20}	34^{12}	18	30	20	33	.
Tilia cordata	.	2	.	.	25^{11}	22^{10}	.	3	54^{25}	49^{22}
Sorbus aucuparia	31	25^{11}	8	42^{19}	12^{4}	18^{7}	48^{22}	8	15	.
Scrophularia nodosa	.	2	4	31^{13}	17^{7}	28^{12}	4	8	24^{10}	34^{15}
Primula elatior	.	.	4	23^{13}	31^{18}	25^{14}	.	25^{15}	15^{8}	.
Equisetum arvense	15	12	42^{14}	15	24^{7}	21^{6}	9	20^{6}	.	2
Carpinus betulus	.	2	.	.	33^{13}	13	.	8	22^{8}	47^{19}
Stellaria holostea	.	2	4	.	33^{15}	21^{9}	.	17^{7}	44^{21}	.
Milium effusum	.	3	4	15^{7}	23^{12}	10	.	19^{9}	34^{18}	26^{13}
Alliaria petiolata	.	.	.	2	22^{11}	37^{20}	.	7	32^{17}	28^{14}
Brachythecium rutabulum	50^{17}	17	60^{20}	48^{16}	18^{4}	29^{9}	10	46^{15}	20	20
Corylus avellana	.	3	.	10	22^{10}	34^{17}	.	7	29^{14}	.
Paris quadrifolia	.	6	.	10	19^{13}	28^{19}	.	7	22^{15}	15^{10}
Heracleum sphondylium	.	.	4	37^{11}	21^{5}	19	4	8	15	.
Galeopsis tetrahit s.l.	8	16	8	37^{12}	10	21^{6}	9	5	15	2
Cirsium palustre	62^{20}	25^{6}	46^{14}	19	6	3	43^{13}	10	.	.
Rhizomnium punctatum	10	21^{12}	10	24^{14}	22^{12}	3	10	20^{11}	.	.
Juncus effusus	23	20	54^{17}	6	3	3	61^{19}	14	.	.
Dactylis glomerata	.	3	8	27	15	10	13	10	12	2
Polygonatum multiflorum	.	2	.	4	17^{9}	19^{10}	.	2	39^{21}	4
Dryopteris filix-mas	.	2	.	14	19^{6}	9	17	12	10	.
Fragaria vesca	.	2	.	14	17^{5}	19^{6}	13	10	7	.
Elymus caninus	.	.	4	25^{21}	11^{9}	21^{17}	.	3	10	15^{12}
Maianthemum bifolium	8	8	.	17^{6}	10	7	17	3	17	17
Symphytum officinale	.	9	17	4	7	13	.	5	2	40^{18}
Rumex obtusifolius	8	14	12	14	6	7	.	19^{6}	10	4
Glyceria fluitans	31^{17}	20^{11}	4	8	2	6	39^{22}	17^{9}	2	.

Group no.	1	2	3	4	5	6	7	8	9	10
Association	TA	CeA	CaA	Ai	SA	PF	PA	CrF	FU	FpU
No. of relevés	13	64	24	52	126	67	23	59	41	47
Lysimachia nemorum	.	2	.	21^{15}	6	.	26^{18}	34^{23}	2	.
Campanula trachelium	.	.	.	.	17^{9}	16^{8}	.	2	22^{12}	13
Ulmus glabra	.	2	.	10^{8}	26^{22}	.	4	8^{7}	5	.
Cornus sanguinea	.	.	.	.	11^{7}	27^{19}	.	2	17^{12}	15^{10}
Veronica chamaedrys	.	.	.	17	2	13	13	2	12	$.^{6}$
Anthriscus sylvestris	.	.	4	13	8	21^{6}	.	5	22^{7}	2
Ranunculus auricomus agg.	.	8	25	2	3	22^{6}	4	10	10	6
Acer platanoides	.	.	.	15^{12}	17^{13}	10^{8}	.	2	12^{9}	.
Melica nutans	.	.	.	4	18^{7}	12	.	12	10	10
Eurhynchium hians	.	4	.	6	20^{9}	26^{12}	.	20^{9}	13	.
Lythrum salicaria	46^{19}	27^{10}	29^{11}	.	.	3	.	3	5	11
Chaerophyllum aromaticum	.	.	.	4	13^{8}	27^{16}	.	2	5	.
Galium odoratum	.	.	.	2	20^{6}	.	.	14	7	.
Stellaria alsine	.	8	17^{13}	6	2	6	30^{23}	19^{14}	2	.
Lapsana communis	.	.	.	4	5	7	.	.	7	47^{21}
Poa palustris	.	6	4	12	2	3	.	8	2	34^{15}
Vaccinium myrtillus	54^{16}	6	.	6	.	.	78^{24}	5	2	.
Betula pendula	38^{19}	12^{5}	4	2	7	9	13	.	2	.
Epilobium montanum	.	3	.	25^{13}	6	1	9	10	2	.
Colchicum autumnale	.	.	4	.	6	27^{15}	.	3	10	2
Valeriana dioica	15	6	12	2	3	4	35^{16}	12	.	.
Calamagrostis villosa	.	.	.	31^{12}	1	.	48^{20}	5	.	.
Carex vesicaria	15	30^{17}	25^{14}	2	.	1	.	2	.	2
Lychnis flos-cuculi	.	12	38^{11}	4	.	1	13	3	.	13
Calamagrostis arundinacea	.	5	.	21^{7}	7	6	4	3	2	.
Mentha arvensis	.	14^{6}	8	4	1	1	13	3	3	19^{8}
Sambucus racemosa	.	.	.	23^{19}	3	6	4	12^{10}	5	.
Climacium dendroides	40	17	.	15	.	8	10	6	.	.
Convallaria majalis	.	.	.	.	5	6	.	.	15	28^{14}
Prenanthes purpurea	.	.	.	33^{16}	5	.	9	7	.	.
Glyceria maxima	15	36^{21}	4	.	.	3	.	.	.	.
Polytrichum formosum	10	.	.	3	5	.	60^{17}	6	.	.
Persicaria hydropiper	.	23^{12}	8	.	2	1	.	3	2	6
Veronica hederifolia agg.	.	.	.	.	2	9	.	.	29^{17}	11
Equisetum palustre	8	3	25	10	2	1	4	10	.	.
Chaerophyllum temulum	.	.	.	.	3	6	.	.	12^{11}	26^{23}
Prunella vulgaris	8	2	4	.	3	.	4	.	.	34^{12}
Carex acuta	15	19^{8}	12	.	1	1	.	.	.	11^{3}
Bistorta major	.	2	4	33^{12}	1	3	9	.	.	.
Agrostis capillaris	8	3	.	12	1	3	43^{10}	2	.	.
Anthriscus nitida	.	.	.	19^{24}	6^{8}	1	.	2	5	.
Tilia platyphyllos	.	.	.	.	2	7^{6}	.	.	10^{8}	23^{20}
Galeopsis pubescens	.	.	8	.	2	1	.	.	7	28^{21}
Avenella flexuosa	.	.	.	6	2	1	48^{13}	2	5	.
Bidens frondosa	.	11^{9}	.	.	.	3	.	.	.	26^{21}
Luzula luzuloides	.	.	.	23^{7}	2	1	4	.	7	.
Epilobium ciliatum	.	12^{8}	8	4	1	4	9	.	.	.

Group no.	1	2	3	4	5	6	7	8	9	10
Association	TA	CeA	CaA	Ai	SA	PF	PA	CrF	FU	FpU
No. of relevés	13	64	24	52	126	67	23	59	41	47
Holcus lanatus	15	8	12	2	2	4	4	.	.	.
Calamagrostis epigejos	.	11	12	.	1	.	4	2	9	.
Carex echinata	38^{22}	3	4	.	.	.	30^{17}	.	2	.
Molinia caerulea s.l.	38^{14}	9	.	.	2	.	9	.	.	.
Geranium sylvaticum	.	.	.	25^{19}	2	.	.	.	.	.
Cirsium heterophyllum	.	.	.	23^{21}	.	.	17^{16}	.	.	.
Agrostis canina	38^{17}	3	.	2	1	.	26^{11}	.	.	.
Ranunculus flammula	8	16^{10}	4	2	1	.	.	2	.	.
Carex muricata agg.	.	.	.	.	.	1	.	.	.	30^{21}
Stachys palustris	.	.	4	.	.	.	.	.	.	28^{19}
Agrostis stolonifera	31	3	.	.	.	1	9	5	.	2
Carex elata	8	19^{23}	.	.	.	.	.	.	.	.
Luzula sylvatica	.	.	.	25^{21}	.	.	.	.	.	.
Polytrichum commune	40^{16}	4	.	.	.	.	30	3	.	.
Tephroseris crispa	.	2	8	6	.	.	22^{19}	2	.	.
Lemna minor	8	14	8	.	.	.	.	.	.	.
Rumex arifolius	.	.	.	21^{19}	.	.	.	2	.	.
Pinus sylvestris	38^{19}	3	.	.	1	1	4	.	2	.
Mentha aquatica	8	5	21^{20}	.	.	1	.	2	.	.
Calliergonella cuspidata	.	21	20	.	1	3	.	6	.	.
Epilobium palustre	23	8	.	.	.	1	9	.	.	.
Potentilla erecta	15	.	.	4	.	.	22	2	.	.
Cirsium arvense	.	.	.	.	.	.	.	.	.	21
Brachythecium rivulare	.	4	.	.	5	.	20	.	.	.
Carex pallescens	.	.	.	2	2	.	22^{10}	2	.	.
Sphagnum recurvum agg.	40^{16}	4	.	.	.	.	10	3	.	.
Carex pilulifera	.	.	.	2	.	.	26^{16}	.	.	.
Sphagnum palustre	30^{20}	4	.	.	.	.	20	.	.	.
Sphagnum teres	20	4	.	.	.	.	.	.	.	.
Menyanthes trifoliata	23^{20}	.	.	.	.	.	.	.	.	.

2. *Carici elongatae-Alnetum glutinosae* Schwickerath 1933 (Mesotrophic and eutrophic alder carr)

Original name: Schwickerath (1933): *Cariceto elongatae-Alnetum glutinosae*
Nomenclatural type: Schwickerath (1933): 117 – holotypus
Definition: *Alnus glutinosa* cover > 25% AND (Group Lysimachia vulgaris AND (Group Carex elongata OR Group Iris pseudacorus) NOT (Group Carex panicea OR Group Carex rostrata OR Group Viola palustris OR Molinia caerulea s.l. cover >15%)

Communities of *Carici elongatae-Alnetum glutinosae* occur on rich fens formed by nutrient-rich organic substrates. *Alnus glutinosa* dominates the tree layer, whereas *Frangula alnus* and *Salix cinerea* frequently appear in the shrub layer. In contrast to *Thelypterido palustris-Alnetum glutinosae* the tree canopy is closed and not stratified. The stands of this association are often composed of sprouting trees of *Alnus glutinosa*. The herb layer is spatially differentiated according to surface heterogeneity: mesophilous species such as *Dryopteris carthusiana* and *Oxalis acetosella* grow on drier hummocks, while hygrophytes and hydrophytes (e.g., *Calamagrostis canescens*, *Carex elongata*, *Iris pseudacorus*, *Lemna minor* and *Lysimachia thyrsiflora*) occur in waterlogged hollows. In comparison to *Thelypterido palustris-Alnetum glutinosae*, species occurring on nutrient-rich soils, such as *Caltha palustris*, *Glyceria maxima*, *Phalaris arundinacea* and *Urtica dioica*, are common and oligotrophic species usually absent.

This community occurs around fishponds, oxbows of large rivers and large spring fed areas at low and middle altitudes (180–560 m). Its area of distribution includes the Třeboňská and Budějovická pánev basins, the Polabská nížina lowland and Českolipsko region. Outside the Czech Republic, *Carici elongatae-Alnetum glutinosae* is recorded in many European countries (Bodeux 1955, Horvat et al. 1974, Korotkov et al. 1991, Borhidi 1996, Prieditis 1997, Šomšák 2000, Willner & Grabherr 2007).

3. *Carici acutiformis-Alnetum glutinosae* Scamoni 1935 nom. invers. et mut. propos. (Graminoid-dominated eutrophic alder carr)

Original name: Scamoni (1935): *Alnus glutinosa-Calamagrostis lanceolata*-Assoziation
Nomenclatural type: Mikyška (1968): 14–20, tab. 1, rel. 8 – neotypus (Neuhäuslová 2003)
Definition: *Alnus glutinosa* cover > 25% AND (Group Cirsium oleraceum OR Group Caltha palustris) AND (*Scirpus sylvaticus* cover > 15% OR *Carex acutiformis* cover > 15%) NOT (Group Asarum europaeum OR Group Carex elongata)

Carici acutiformis-Alnetum glutinosae is most often present in the young successional stages of alder carr growing on eutrophic sites on former wetland grasslands. *Alnus glutinosa* creates monodominant stands with *Frangula alnus* and *Salix cinerea* in the shrub layer. The tree canopy is closed and not stratified. Stands are young and trees do not sprout at this stage. Graminoids dominate the herb layer (especially *Carex acutiformis*, *Scirpus sylvaticus*, *Carex paniculata* and *Carex cespitosa*). Species typical of wet grassland (*Calthion* alliance), probably surviving from previous community types, commonly occur (e.g., *Angelica sylvestris*, *Cirsium oleraceum*, *Cirsium palustre* and *Filipendula ulmaria*). In comparison to *Carici elongatae-Alnetum*, some species (such as *Calamagrostis canescens*, *Carex elongata* and *Peucedanum palustre*) normally associated with more developed successional stages and more oligotrophic sites are rare.

Carici acutiformis-Alnetum occurs widely near fishponds, in large spring fed areas and along streams and rivers in lowlands and foothills (240–650 m a.s.l.). Recently, this community was reported only from the Czech Republic and from Austria (Neuhäuslová 2003, Mucina et al. 1993, Willner & Grabherr 2007 with the rank of subassociation – *Carici elongatae-Alnetum caricetosum acutiformis* Pfadenhauer 1969). Stortelder et al. (1999) record similar communities in the Netherlands.

It is possible to distinguish two vegetation types in *Carici acutiformis-Alnetum*, depending on the nutrient and altitudinal gradient: alder carr dominated by *Carex acutiformis* on euthrophic sites in the lowlands and uplands (240–400 m a.s.l.) and alder carr dominated by *Scirpus sylvaticus* on less eutrophic sites at higher altitudes (400–650 m a.s.l.).

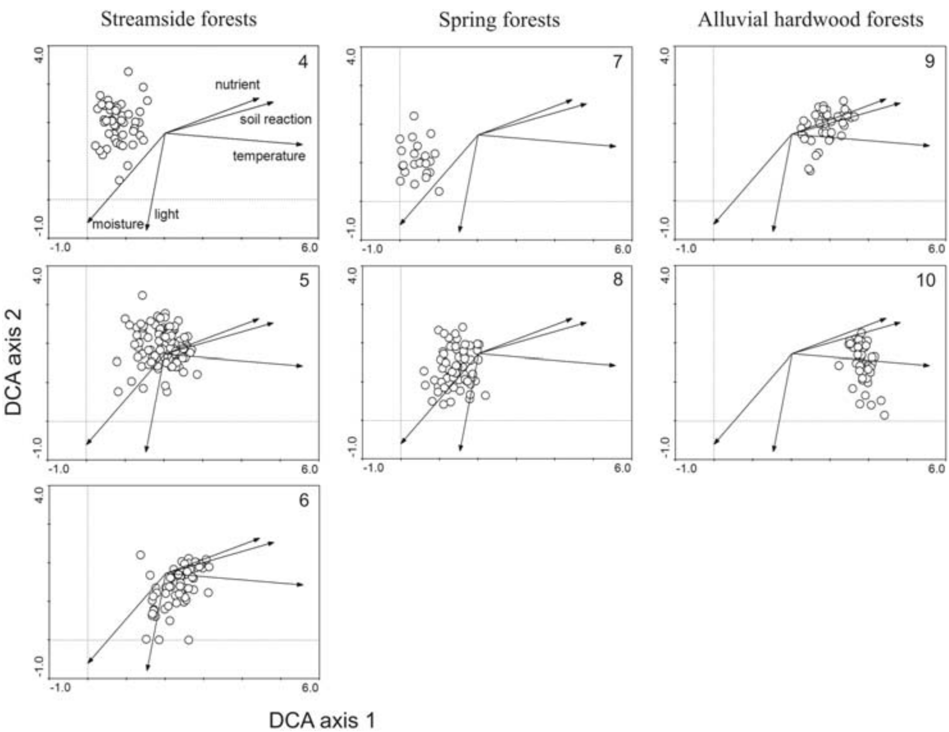

Fig. 3. – DCA ordination diagram of floodplain forests with Ellenberg indicator values as supplementary environmental variables. All plotted variables are correlated with the scores of relevés on the 1st and/or the 2nd ordination axis ($p < 0.001$). Units are separated in ordination space. Different types of habitats are presented in columns. The 1st and the 2nd ordination axes explain 4.0% and 2.1% ($n = 415$) of the total species variability, respectively. 4 – *Alnetum incanae*, 5 – *Stellario nemorum-Alnetum glutinosae*, 6 – *Pruno-Fraxinetum*, 7 – *Piceo-Alnetum*, 8 – *Carici remotae-Fraxinetum*, 9 – *Ficario-Ulmetum campestris*, 10 – *Fraxino pannonicae-Ulmetum.*

Alnion incanae Pawłowski, Sokołowski et Wallisch 1928 (Floodplain forests)

4. *Alnetum incanae* Lüdi 1921 (Montane streamside grey alder forests)

Original name: Lüdi (1921): *Alnetum incanae*
Nomenclatural type: Lüdi (1921): 147 – holotypus
Definition: (*Alnus incana* cover > 15% NOT *Alnus glutinosa* cover > 15%) AND (Group Geranium sylvaticum OR Group Petasites albus)

This species-rich community occurs along the streams and rivers, in mountains and their foothills (360–930 m a.s.l.), on eutrophic sites and sandy-gravel substrates. *Alnus incana* dominates the tree layer with an admixture of *Picea abies* and *Acer pseudoplatanus*. The tree canopy is often open due to frequent disturbances due to flooding. Sprouts of *Alnus incana* and polycormons of *Prunus padus* subsp. *padus* commonly occur in the shrub layer. The species-rich herb layer contains plants resistant to disturbance due to flooding (e.g., *Petasites albus*, *Stellaria nemorum*, *Cardaminopsis halleri* and *Thalictrum* *aquilegiifolium*). In addition, species of mountain tall-herb vegetation are present (e.g., *Aconitum plicatum*, *Doronicum austriacum*, *Cicerbita alpina* and *Ranunculus platanifolius*). These species and nitrophytes such as *Urtica dioica* and *Stachys sylvatica* differentiate *Alnetum incanae* from *Piceo-Alnetum* dominated by *Alnus incana*.

Alnetum incanae is widespread in the border mountains of the Czech Republic. It was recorded in the Krušné hory Mts, Šumava Mts, Novohradské hory Mts, Krkonoše Mts, Adršpašsko-teplické skály region, Orlické hory Mts, Hrubý Jeseník Mts and Moravskoslezské Beskydy Mts. The association is commonly recorded in the mountains of W, S, C, E and SE Europe (Schwabe 1985).

It is possible to distinguish two vegetation types of *Alnetum incanae* in the Czech Republic. The first vegetation type mostly dominated by *Petasites* species and occuring along mountain streams and rivers in narrow valleys is the most frequent. The second vegetation type develops along mountain rivers in large floodplains. Species characteristic of this vegetation type are: *Betula pubescens*, *Calamagrostis villosa*, *Cirsium heterophyllum*, *Phalaris arundinacea* and *Viola palustris*. This vegetation type, occuring in the Šumava Mts, is analogous to the north European floodplain forests of *Pruno padi-Alnetum incanae* Kielland-Lund ex Aune 1973 (Sádlo & Bufková 2000).

5. *Stellario nemorum-Alnetum glutinosae* Lohmeyer 1957
(Eutrophic streamside ash-alder forests)

Original name: (Lohmeyer 1957): *Stellario-Alnetum glutinosae* [Kästner 1938]
Nomenclatural type: Lohmeyer (1957): tab. 1, rel. 17 – lectotypus (Neuhäuslová 2000)
Definition: (*Alnus glutinosa* cover > 25% OR (*Fraxinus excelsior* cover > 25% AND Group Cardamine amara)) AND (Group Asarum europaeum OR Group Mercurialis perennis) NOT (Group Prunus padus OR Group Lysimachia vulgaris OR *Cardamine amara* cover > 5% OR *Carex remota* cover > 5%)

This species-rich community dominated by *Alnus glutinosa* or *Fraxinus excelsior* occurs in narrow valleys along small streams on euthrophic sites. Typically, the localities for this association are strongly influenced by water erosion, fluvial and slope sedimentation. Consequently, the microrelief and substrate are very diverse and herbs with different moisture requirements can occur there (e.g., *Asarum europaeum*, *Euphorbia dulcis*, *Galeobdolon luteum* s.l., *Lycopus europaeus*, *Stachys sylvatica*, *Stellaria nemorum* and *Veronica beccabunga*).

In the Czech Republic, *Stellario nemorum-Alnetum glutinosae* is common up to 900 m a.s.l. It is widespread in the uplands and mountains of W and C Europe (Mucina & Maglocký 1985, Mucina et al. 1993, Pott 1995, Neuhäuslová 2000, Matuszkiewicz 2002). An analogous vegetation type is recorded from Hungary as *Aegopodio-Alnetum* Karpáti et Karpáti 1961 (Borhidi 1996).

It is possible to distinguish two vegetation types depending on the altitudinal gradient. The first vegetation type, distributed especially in uplands, is characterized by the occurrence of more thermophilous and nitrophilous species (e.g., *Acer campestre*, *Brachypodium sylvaticum* and *Impatiens parviflora*). The second vegetation type, typical of mountains, is distinguished by the presence of mountain species and species characteristic of beech forests (e.g., *Alnus incana*, *Galium odoratum*, *Petasites albus*, *Silene dioica* and *Thalictrum aquilegiifolium*).

6. *Pruno-Fraxinetum* Oberdorfer 1953 (Eutrophic alluvial ash-alder forests)

Original name: Oberdorfer (1953): *Pruneto-Fraxinetum*
Nomenclatural type: Moor (1958): tab. 30, rel. 1 – neotypus (Neuhäuslová 2000)
Definition: Group Prunus padus AND (*Alnus glutinosa* cover > 25% OR *Fraxinus excelsior* cover > 25%) NOT (Group Cardamine amara OR Group Galium odoratum OR Group Carex elongata)

Ash-alder alluvial forests that develop on large floodplains on eutrophic soils formed by a thick layer of silt and loamy sediments. The tree layer is dominated by *Alnus glutinosa* or *Fraxinus excelsior*, with a frequent admixture of *Tilia cordata*. The shrub layer is well developed. Hygrophilous shrubs (*Euonymus europaeus*, *Prunus padus* subsp. *padus* and *Ribes rubrum*) are characteristic. Nitrophilous herbs with a phenological optimum in summer, such as *Urtica dioica*, *Humulus lupulus* and *Rubus caesius*, and species of the *Calthion* alliance (e.g., *Filipendula ulmaria*, *Cirsium oleraceum* and *Lysimachia vulgaris*) are present. *Fagetalia* species occur relatively rarely, except for the common *Brachypodium sylvaticum* and *Pulmonaria officinalis* s.l.

Pruno-Fraxinetum is widespread on the alluvia of rivers and large streams from the lowlands to foothills (most frequently below 500 m a.s.l.). It is reported from W and C Europe (e.g., Oberdorfer 1953, Stortelder et al. 1999).

7. *Piceo-Alnetum* Mráz 1959 (Oligotrophic spring spruce-alder forests)

Original name: Mráz (1959): *Piceo-Alnetum*
Nomenclatural type: Mráz (1959): 173–175, tab. 5, rel. 248 – lectotypus hoc loco
Definition: (*Alnus glutinosa* cover > 25% OR *Alnus incana* cover > 25%) AND (Group Vaccinium myrtillus OR Group Viola palustris) NOT (Group Carex elongata OR Group Lysimachia vulgaris OR Group Carex acuta OR Group Urtica dioica)

Waterlogged forests on acidic and nutrient-poor substrates occuring in spring fed areas in the highlands and mountains (most frequently 550–900 m a.s.l.). The tree layer is dominated either by *Alnus glutinosa* or *Alnus incana*, with an admixture of *Picea abies* and *Sorbus aucuparia*. On heavily waterlogged sites the canopy is frequently open. The shrub layer is formed by shade-tolerant *Frangula alnus* and *Picea abies* seedlings. Acidophytes (e.g., *Vaccinium myrtillus* and *Avenella flexuosa*), cold-demanding species (e.g., *Calamagrostis villosa* and *Equisetum sylvaticum*) and those growing in spring fed areas (e.g., *Viola palustris*, *Chaerophyllum hirsutum* and *Crepis paludosa*) occur in the herb layer. The common presence of nitrophytes such as *Rubus idaeus* and *Senecio nemorensis* agg. indicates good mineralization of humus. The moss layer plays an important role in the community structure (e.g., *Polytrichum commune*, *Pellia neesiana* and *Scapania undulata*).

The centre of distribution of *Piceo-Alnetum* is S and SW Bohemia (Český les Mts, Šumava Mts and Novohradské hory Mts). This community was also recorded in the Českomoravská vrchovina highlands, Lužické hory Mts, Hrubý Jeseník Mts and Moravskoslezské Beskydy Mts. Outside the Czech Republic, this association was recently recorded in Slovakia (Mucina & Maglocký 1985). An analogous vegetation type is reported under various names from Germany (Oberdorfer 1992, Walentovski et al. 2006), Austria (Willner & Grabherr 2007) and Poland (Sokołowski 1980).

8. *Carici remotae-Fraxinetum* Koch ex Faber 1936 (Eutrophic spring ash-alder forests)

Original name: Faber (1936): *Cariceto remotae-Fraxinetum* (W. Koch 1926)
Nomenclatural type: Faber (1936): 42–49, col. D_1, rel. 1 – lectotypus (Neuhäuslová 2000)
Definition: (*Alnus glutinosa* cover > 5% OR *Fraxinus excelsior* cover > 5%) AND (Group Cardamine amara AND (*Cardamine amara* cover > 5% OR *Carex remota* cover > 5%)) NOT (Group Carex acuta OR Group Lysimachia vulgaris OR Group Carex elongata OR Group Vaccinium myrtillus)

This community occurs in nutrient-rich spring fed areas along streams and on the slopes of valleys. The tree layer is most often dominated by *Alnus glutinosa* and *Fraxinus excelsior*. As in the previous association, the tree canopy is often open on heavily waterlooged sites. In the herb layer, species of spring fed areas prevail (e.g., *Carex remota*, *Cardamine amara*, *Chaerophyllum hirsutum*, *Crepis paludosa* and *Myosotis palustris* agg.). Unlike the association *Piceo-Alnetum,* acidophytes are absent and euthrophic herbs, such as *Carex sylvatica*, *Festuca gigantea*, *Impatiens noli-tangere, Stellaria nemorum* and *Urtica dioica*, are common. Compared to *Stellario nemorum-Alnetum glutinosae* mesophytes are rare (*Asarum europaeum*, *Pulmonaria officinalis* s.l. and *Stellaria holostea*).

Carici remotae-Fraxinetum is widespread all over the Czech Republic from the lowlands to the mountains (210–750 m a.s.l.). Outside the Czech Republic, it is reported from W, C, E and SE Europe (Oberdorfer 1953, Horvat et al. 1974, cf. Rodwell 1991, Borhidi 1996, Prieditis 1997, Stortelder et al. 1999).

9. *Ficario-Ulmetum campestris* Knapp ex Medwecka-Kornaś 1952 (Elm-ash-oak alluvial hardwood forests)

Original name: Medwecka-Kornaś (1952): *Ficario-Ulmetum campestris* Knapp 1942
Nomenclatural type: Medwecka-Kornaś (1952): 184–185 – holotypus
Definition: (*Quercus robur* cover > 5% NOT *Alnus glutinosa* cover > 15%) AND (Group Corydalis cava OR *Prunus padus* subsp. *padus* cover > 5%) NOT (Group Cardamine amara OR Group Lathyrus vernus OR *Fraxinus angustifolia*)

Community occuring on large floodplains of rivers in the lowlands and uplands (150–530 m a.s.l.). The species-rich tree layer is dominated by *Quercus robur* and *Fraxinus excelsior*, with an admixture of *Ulmus laevis*, *U. minor* and *Acer campestre*. Thanks to sufficient light the shrub layer is well developed (e.g., *Prunus padus* subsp. *padus*, *Sambucus nigra* and seedlings of *Fraxinus excelsior* and *Acer campestre*). Early spring species such as *Corydalis cava*, *Ficaria verna* subsp. *bulbifera*, *Gagea lutea*, *Anemone ranunculoides* and *A. nemorosa*, and also nitrophytes (e.g., *Aegopodium podagraria*, *Urtica dioica*, *Lamium maculatum* and *Brachypodium sylvaticum*) are common in the herb layer.

Ficario-Ulmetum campestris is widespread along large rivers particularly in the lowland regions of the Czech Republic, and is also recorded at higher altitudes (the Třeboňská pánev basin in S Bohemia). Generally, this community occurs in W and C Europe (syn: *Querco-Ulmetum* Issler 1926 nom. inv., *Fraxino-Ulmetum* Tüxen ex Oberdorfer 1953; Mucina et al. 1993, Pott 1995, Stortelder et al. 1999, Matuszkiewicz 2002, Willner & Grabherr 2007).

10. *Fraxino pannonicae-Ulmetum* Aszód 1935 corr. Soó 1963
(Pannonian alluvial hardwood forests)

Original name: Aszód (1935): *Fraxineto-Ulmetum*
Nomenclatural type: Kevey (2007): 105–115, tab. 1, rel. 1 – neotypus hoc loco
Definition: *Fraxinus angustifolia* cover > 5% AND (Group Urtica dioica OR Group Symphytum officinale)

Community dominated by *Fraxinus angustifolia* subsp. *danubialis* occurring on deep nutrient-rich fluvial sediments in the Pannonian lowland (Pannonian region). Like the previous community *Ficario-Ulmetum campestris*, a high diversity of trees is characteristic of this association. In addition to *Fraxinus angustifolia* subsp. *danubialis*, *Carpinus betulus* and *Quercus robur* dominate in the tree layer. Elms (*Ulmus laevis*, *Ulmus minor*) are a common admixture. Unlike *Ficario-Ulmetum campestris, Fagetalia* species (e.g., *Galeobdolon luteum* s.l., *Mercurialis perennis*) are rare. Hygrophytes (*Deschampsia cespitosa*, *Galium palustre* agg. and *Carex remota*) and nitrophytes (*Torilis japonica*, *Cardamine impatiens* and *Lapsana communis*) often occur together in the herb layer. The presence of *Fraxinus angustifolia* subsp. *danubialis* and *Carex strigosa* characterizes the Pannonian floodplain forests in the Czech Republic.

Fraxino pannonicae-Ulmetum is widespread in the Panonnian region in the S part of Moravia along the Morava and the Dyje rivers (150–180 m). This association is also reported from Slovakia (Mucina & Maglocký 1985), Austria (Willner & Grabherr 2007) and Hungary (Borhidi 1996). Similar communities occur in Romania, Bulgaria and the former Yugoslavia (Horvat et al. 1974).

Which ecological gradients correspond to the classification?

The ordination diagrams (Fig. 1, 3) show various important environmental gradients (revealed by Ellenberg indicator values), which are associated with vegetation variability within the alliances *Alnion glutinosae* and *Alnion incanae*, respectively.

The variability of *Alnion glutinosae* shown by the 1st and the 2nd DCA axis is correlated especially with nutrient availability, soil reaction and moisture (Fig. 1). The order of the associations along the 1st DCA axis (*Thelypterido palustris-Alnetum glutinosae – Carici elongatae-Alnetum glutinosae – Carici acutiformis-Alnetum glutinosae*) corresponds to a vegetation gradient from oligotrophic and heavy waterlogged to eutrophic and drier sites. Unlike in the alliance *Alnion incanae*, continentality has an important role. The highest continentality values correspond with the association *Thelypterido palustris-Alnetum glutinosae*, which commonly contains species with a boreo-continental distribution (e.g., *Trientalis europaea*, *Pinus sylvestris*). On the other hand, the temperature values (based on the occurrence of mountain vs. lowland species) are not so important in alder carr. This is probably due to their more azonal character (Bodeux 1955, Döring-Mederake 1990) and the fact that they occur over a narrower altitudinal range compared to *Alnion incanae* in the Czech Republic.

Within the *Alnion incanae* alliance, the temperature value (based on the occurrence of mountain *vs.* lowland species) is positively correlated with nutrient availability and soil reaction. Moisture is positively correlated with light. These are important factors affecting the variability of this alliance (Fig. 3). The analogous environmental gradients (i.e., nutrient availability, soil reaction, light and moisture) responsible for vegetation variability of *Alnion incanae* forests are cited by Härdtle et al. (2003a, b). Temperature is the most important factor correlated with vegetation gradient on the 1st DCA axis. According to this gradient, the associations are ordered in the following way: mountain association *Alnetum incanae* – upland and mountain associations *Piceo-Alnetum*, *Carici remotae-Fraxinetum* and *Stellario nemorum-Alnetum glutinosae* – upland and lowland association *Pruno-Fraxinetum* – lowland associations *Ficario-Ulmetum campestris* and *Fraxino pannonicae-Ulmetum*. Moisture is obviously independent of temperature (Fig. 3). This fact is probably due to the occurrence of spring fed forests along the whole altitudinal gradient: from mountains to lowlands: *Piceo-Alnetum, Carici remotae-Fraxinetum*, and moist vegetation types within *Pruno-Fraxinetum* and *Fraxino pannonicae-Ulmetum*.

Notes on the classification and syntaxonomical and nomenclatural changes

The associations *Arunco sylvestris-Alnetum glutinosae* Tüxen 1957, *Fraxino-Populetum* Jurko 1958, *Querco-Populetum* Neuhäuslová-Novotná 1965 and *Pruno padi-Quercetum roboris* Neuhäuslová et Kučera 2004, which were recently recorded in the Czech Republic (Neuhäuslová 2000, Neuhäuslová & Kučera 2004), are not distinguished in this paper. These units were assigned to associations with analogous species composition and are considered to be synonyms (the only exception being *Fraxino-Populetum*).

The relevés from foothill and mountain streamside forests of *Arunco sylvestris-Alnetum glutinosae* were most often assigned to *Stellario nemorum-Alnetum glutinosae*, which accords with the approach of Oberdorfer (1992), Mucina et al. (1993) and Willner & Grabherr (2007). These authors regard this association as a mountain form of *Stellario nemorum-Alnetum glutinosae*.

The relevés of alluvial hardwood forests of *Fraxino-Populetum* recorded in the Dolnomoravský úval lowland along the Morava river (e.g., Neuhäuslová 2000) were classified within *Fraxino pannonicae-Ulmetum*. Outside the Czech Republic, *Fraxino-Populetum* is recorded along the Danube river in Austria and Slovakia (Jurko 1958, Wendelberger & Wendelberger 1956, Mucina & Maglocký 1985, Mucina et al. 1993, Willner & Grabherr 2007), but with different species composition. Compared with the relevés from the Czech Republic, these stands are dominated by *Populus alba* and, especially in Austria, contain specific diagnostic species such as *Alnus incana* and *Acer pseudoplatanus* (Jurko 1958, Mucina et al. 1993, Willner & Grabherr 2007). Hence, after comparison with the original diagnosis of Jurko (1958), there is no indication that this association occurs in the Czech Republic. The wet and more nitrophilous stands of *Fraxino pannonicae-Ulmetum* shown in the DCA analysis (Fig. 3) could be classified as internal units of this association as in the studies of Soó (1958), Džatko (1972), Neuhäuslová (2000) and Willner & Grabherr (2007).

The *Querco-Populetum* association recorded at the junction of the Vltava and Labe rivers, on the Hornomoravský úval lowland (Neuhäuslová 2000) and Slovakia (Mucina & Maglocký 1985), is considered to be a wet and more nitrophilous vegetation type of *Ficario-Ulmetum campestris*. In terms of species composition, this vegetation type does not differ markedly from the original diagnosis of *Ficario-Ulmetum campestris* in Neuhäuslová-Novotná (1965).

The regional association of *Pruno padi-Quercetum roboris* reported from S Bohemia and characterized by a higher occurrence of acidophytes, such as *Carex brizoides* and *Maianthemum bifolium* (Neuhäuslová & Kučera 2004), was not distinguished. Along the moisture gradient, its relevés were assigned to *Pruno-Fraxinetum* and *Ficario-Ulmetum campestris*.

A rare community of *Alnus-Rubus saxatilis* reported by Sádlo (2000) from C Bohemia and probably occurring also in other regions, was not distinguished because of the small number of available relevés and large variability in species composition of this vegetation type. This community develops on oligotrophic but calcareous spring fed areas or fens. The *Alnus-Rubus saxatilis* community is similar to *Thelypterido palustris-Alnetum glutinosae* in terms of the occurrence of oligotrophic species (e.g., *Agrostis canina*, *Potentilla erecta*). However, the calcareous site conditions together with specific species composition (e.g., *Carex davalliana*, *Carex flacca*) distinguish this community from *Thelypterido palustris-Alnetum glutinosae*.

Most of the cited syntaxonomical names correspond to those used in the lists of vegetation units of the Czech Republic (Neuhäuslová 2000, 2003). The few differences in the names of units introduced in this paper need qualification. *Thelypterido palustris-Alnetum glutinosae* described by Klika (1940) was used for oligotrophic and acidic *Sphagnum*-rich alder carr instead of the *Calamagrostio canescentis-Alnetum* (Scamoni 1935) proposed recently for the Czech Republic (Neuhäuslová 2003). The reason for this substitution is the discrepancy between the interpretation of Neuhäuslová (2003) and the original diagnosis of Scamoni (1935). In the original diagnosis of Scamoni (1935), *Calamagrostio canescentis-Alnetum* comprises many eutrophic species (e.g., *Carex elongata*, *Glechoma hederacea*, *Geranium robertianum*, *Ranunculus repens* and *Urtica dioica*). Therefore, it is possible to consider it as a synonym of *Carici elongatae-Alnetum* Schwickerath 1933. In contrast, Klika (1940) in his original diagnosis of *Thelypterido palustris-Alnetum glutinosae* mentions numerous acidophytes and oligotrophic species (e.g., *Carex nigra*, *Carex canescens*, *Menyanthes trifoliata*, *Sphagnum recurvum* agg. and *Betula pubescens*), as well as *Pinus sylvestris* in the tree layer. In the Czech Republic, these species characterize *Sphagnum*-rich alder carr (Table 2). In the context of central Europe the syntaxonomy of *Sphagnum*-rich alder carr is much more complicated. The name *Sphagno squarrosi-Alnetum* has recently been used in Poland for this vegetation type (Solinska-Górnicka 1987, Prieditis 1997, Matuszkiewicz 2002). Passarge & Hoffman (1968) record *Sphagno-Alnetum* Doing 1962 in NE Germany. In Austria, Willner & Grabherr (2007) record *Sphagno-Alnetum* Lemée 1937, which seems strange as this denomination is commonly used for alder communities in oceanic regions of Europe (Oberdorfer 1992, Pott 1995, Prieditis 1997). Other authors (Pott 1995, Döring-Mederake 1990, Šomšák 2000, Neuhäuslová 2003) have a broader concept of *Carici elongatae-Alnetum*: in fact the subassociation *C. e.-A. betuletosum* is very similar to *Thelypterido palustris-Alnetum glutinosae*. There are only small differences among these communities, therefore I consider the name *Thelypterido palustris-Alnetum glutinosae* valid for all the above mentioned *Sphagnum*-rich alder carr.

Oligotrophic and mesotrophic spring forests with acidophyte species are identified as *Piceo-Alnetum* Mráz 1959 rather than *Piceo-Alnetum* Rubner ex Oberdorfer 1957 (Neuhäuslová 2000). The reason for this substitution is that the original diagnosis of Oberdorfer (1957) is invalid (see also Neuhäuslová in Moravec et al. 1982; article 2b in Weber et al. 2000). In Germany and Austria a similar vegetation type was recently recorded as *Circaeo-Alnetum* Oberdorfer 1953 or a mountain form of *Pruno-Fraxinetum* Oberdorfer 1953 (Oberdorfer 1992, Walentowski et al. 2006, Willner & Grabherr 2007). However, the original diagnoses of both *Circaeo-Alnetum* Oberdorfer 1953 and *Pruno-Fraxinetum* Oberdorfer 1953 contain eutrophic species and nitrophytes (e.g., *Urtica dioica*, *Galium* *aparine* and *Geranium robertianum*) (Oberdorfer 1953). These species distinguish these communities from stands described as *Piceo-Alnetum* in the relevés from the Czech Republic. For these reasons, these names are not accepted in this paper.

I use *Ficario-Ulmetum campestris* Knapp ex Medwecka-Kornaś 1952 instead of *Querco-Ulmetum* Issler 1926, which is commonly used in central Europe (Mucina & Maglocký 1985, Oberdorfer 1992, Mucina et al. 1993, Pott 1995, Neuhäuslová 2000), because the original diagnosis of Issler (1926) is invalid (Willner & Grabherr 2007). I prefer *Ficario-Ulmetum campestris* (Medwecka-Kornaś 1952) to *Fraxino-Ulmetum* Tüxen ex Oberdorfer 1953 mentioned by Willner & Grabherr (2007), because the former represents an older valid name of this vegetation type.

My concept of *Carici acutiformis-Alnetum* is of an eutrophic alder carr with a frequent occurrence of meadow species. This concept corresponds to the original diagnosis of Scamoni (1935). However, in the Czech Republic, the lowland communities on waterlogged sites, especially in the oxbows of large rivers, are also frequently assigned to *Carici acutiformis-Alnetum*. The only reason for this classification of these communities is the dominance of tall sedges (*Carex acutiformis* or *Carex riparia*) because species of wetland meadows are absent and those of *Carici elongatae-Alnetum* are common. In this paper, these communities are assigned to *Carici elongatae-Alnetum*.

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Souhrn

V předkládaném článku je provedena fytocenologická revize společenstev mokřadních olšin (svaz *Alnion glutinosae*) a lužních lesů (svaz *Alnion incanae*) České republiky. Formalizovanou klasifikační metodou Cocktail, která využívá pro definování fytocenologických jednotek sociologické skupiny druhů, byly rozlišeny 3 asociace svazu *Alnion glutinosae* a 7 asociací svazu *Alnion incanae*.

V rámci mokřadních olšin byly rozlišeny oligotrofní rašelinné olšiny (*Thelypterido palustris-Alnetum glutinosae* Klika 1940), mezotrofní až eutrofní olšiny s bulty (*Carici elongatae-Alnetum glutinosae* Schwickerath 1933) a eutrofní, nejčastěji sukcesně mladé olšiny s dominantními graminoidy a hojným výskytem druhů svazu *Calthion* (*Carici acutiformis-Alnetum glutinosae* Scamoni 1935).

Lužní lesy byly rozděleny na potoční luhy, prameništní lesy a tvrdé luhy. V rámci potočních luhů byla rozlišena silně nitrofilní asociace *Pruno-Fraxinetum* Oberdorfer 1953 vázaná na široké a zahliněné nivy, druhově bohatá asociace úzkých údolí *Stellario nemorum-Alnetum glutinosae* Lohmeyer 1957 a horská asociace *Alnetum incanae* Lüdi 1921 s dominantní olší šedou. Prameništní lesy zahrnují asociaci *Carici remotae-Fraxinetum* Koch ex Faber 1936, vázanou na eutrofní stanoviště, a asociaci *Piceo-Alnetum* Mráz 1959, která se vyskytuje na kyselých a převážně oligotrofních stanovištích. V rámci tvrdých luhů byly rozlišeny dvě fytogeograficky definované asociace; *Ficario-Ulmetum campestris* Medwecka-Kornaś 1952, která se vyskytuje v nižších a středních polohách podél řek po celém území České republiky, a panonská asociace *Fraxino pannonicae-Ulmetum* Aszód 1935 corr. Soó 1963, která je svým rozšířením omezena pouze na nejjižnější část Moravy.

Oproti současným studiím z České republiky (Nehäuslová 2000, 2003, Neuhäuslová & Kučera 2004) nebyly rozlišeny 4 asociace lužních lesů (*Arunco sylvestris-Alnetum glutinosae* Tüxen 1957, *Pruno padi-Quercetum roboris* Neuhäuslová et Kučera 2004, *Querco-Populetum* Neuhäuslová-Novotná 1965 a *Fraxino-Populetum* Jurko 1958), které nebylo možné odlišit od asociací s podobným druhovým složením. Zároveň byly provedeny následující nomenklatorické změny. Jména *Calamagrostio canescentis-Alnetum* Scamoni 1935, *Piceo-Alnetum* Rubner ex Oberdorfer 1957 a *Querco-Ulmetum* Issler 1926 byla nahrazena jmény *Thelypterido palustris-*

Alnetum glutinosae Klika 1940, *Piceo-Alnetum* Mráz 1959 a *Ficario-Ulmetum campestris* Medwecka-Kornaś 1952, aniž by došlo ke změně pojetí těchto jednotek.

Pomocí Ellenbergových indikačních hodnot druhů byly zjištěny faktory prostředí odpovědné za hlavní vegetační gradienty ve fytocenologických datech. V rámci svazu *Alnion glutinosae* vysvětlují nejdelší gradient zobrazený pomocí 1. ordinační osy DCA zejména dostupné živiny, půdní reakce a vlhkost, u svazu *Alnion incanae* se jedná hlavně o teplotu vyjádřenou v případě Ellenbergových indikačních hodnot výskytem horských a nížinných druhů, půdní reakci, dostupné živiny a vlhkost.

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